stone are termed Middle Carboniferous. Indeed, looking at the subject from the point of view of physical geology, Dr. Newberry adopts a well-known principle, and also assigns the whole of the Carboniferous Limestone of Western Europe to the middle portion of the Carboniferous epoch, considering that this great division of time terminates with the upper limit of the Permian. The fishes of the Chemung and Catskill groups comprise, among others, the genera *Palædaphus* (*Heliodus*), *Phyllolepis*, *Bothriolepis*, *Onychodus*, *Holoptychius*, and *Glyptopomus*, all of which are essentially characteristic of the Old Red Sandstone and Devonian of Europe, and are never found in the lowest mechanical sediments of the Carboniferous system even in Scotland; while the remarkable new genus *Holonema* is more suggestive of a Devonian Coccostean than of any later type. The fishes of the Waverly group, on the other hand, agree in general character with those of the Calciferous Sandstone and Carboniferous Limestone series of Scotland, except in one particular—namely, the occurrence in certain American horizons of the remarkable gigantic "Placoderms," to which Dr. Newberry has given the names of *Dinichthys*, *Titanichthys*, *Trachosteus*, *Glyptaspis*, &c.

The detailed descriptions of these genera constitute the most important part of the present volume, and add most materially to existing knowledge of the subject. *Dinichthys* is essentially a huge *Coccosteus*, often with jaws two feet in length. *Titanichthys* is a still more gigantic fish, the head sometimes measuring four feet across, and the long, slender, toothless jaws were apparently provided during life with a horny sheath. Some of the remaining genera are also noteworthy for the elaborate ornamentation of their armour; while at least one other (*Mylostoma*) has loose dental plates very suggestive of those of certain Chimæroids and Dipnoi. The series of *Dinichthys* and its allies in the Museum of Columbia College is, indeed, one of the most remarkable exhibitions to be seen in the institutions of the United States, and deserves the closest attention of all interested in the earliest types of fish life.

A contemporaneous Elasmobranch, occurring in the same formation as *Dinichthys*, is also a most striking addition to the Palæozoic fauna; but it is not described, and only forms the subject of two unsatisfactory plates. The dentition is Cladodont, and the species is named *Cladodus fyleri*, while the anterior half of an allied fish is both described and figured under the name of *Cladodus kepleri*. This form of Elasmobranch has small pectoral fins, with an abbreviated basipterygium, and the cartilaginous rays all extending to the outer border; the tail is attenuated, diphycercal, with a pair of horizontal dermal expansions at its base; there are apparently no dorsal fin-spines; and the orbit is surrounded by a complete ring of four ornamented dermal plates. The fish is altogether different from any hitherto found in Europe provided with *Cladodus*-shaped teeth, and increases the already considerable difficulties surrounding the classification of the predaceous Palæozoic sharks.

The discovery of an undoubted *Rhizodus* in the Carboniferous Limestone of Illinois is another fact of some interest; though in this case, as in several others, the author unfortunately omits to mention that the fossil has already been described, without figure, in the publications of the New York Academy. Several fossil teeth and spines of Elasmobranchs are also discussed from the same formation; and the final section of the work is a brief summary of the fishes of the American Coal-measures, accompanied by a reprint of the author's memoir on *Edestus*, which appeared in the Annals of the New York Academy in 1888. The last-mentioned fossil is still problematical, but is considered to be most nearly paralleled by the group of spines met with upon the tail of the existing *Trygon*.

Dr. Newberry's researches have excited so much interest among geologists residing in the neighbourhood of Palæozoic formations in the United States, that Columbia College is the destination of nearly all new discoveries of Palæozoic fishes from every quarter. So much has thus accumulated since the completion of the manuscript for the present monograph, that we understand the author contemplates the issue of an extensive supplement. That such an additional contribution may soon appear will be the wish of all naturalists interested in this line of research.

A. S. W.

HAND-BOOK FOR MECHANICAL ENGINEERS.

Hand-book for Mechanical Engineers. By Prof. Henry Adams, M.Inst.C.E. (London and New York: E. and F. N. Spon, 1890.)

THIS useful book is practically a new and improved edition of Prof. Adams's previous work, "Notes in Mechanical Engineering" The older work has been recast, and much additional matter added to render it of more use to mechanical engineers and to raise it above the level of the ordinary text book. The author rightly observes that busy men must have facts and opinions put before them as briefly as possible, and this is his reason for condensing the information in the book to a compact yet clear form. The work is sure to be an acceptable one to mechanical engineers. The information has in most cases been taken from trustworthy sources, and these are duly acknowledged. It is a pity that the index has not been differently arranged, for there is nothing more annoying when picking up a book of this kind in order to obtain some particular formula or information than to find that it is necessary to settle in one's mind what section it is likely to be in, and then have to search down the columns for a likely paragraph. Had the index been an alphabetical one pure and simple, the handiness of the book would have been greatly enhanced. In some few cases it will be observed that data are quoted from amateur engineering papers. These may be perfectly correct; at the same time the "busy man" will probably doubt their value and trustworthiness.

The book covers an extensive field of mechanical engineering, most branches being well treated. Some of the information, however, is antiquated; for instance on p. 27, we are told that wrought iron is used for "rails." We presume railway rails are here meant. It must be very many years since the last iron rails were rolled for that purpose, and it is possible that there are no works left in this country where the old iron plant is in existence. On the same page it is stated that Yorkshire iron from Lowmoor, Bowling and other forges is used for

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tyres! This also is distinctly wrong. Who in the year 1890 would use iron tyres on railway rolling stock, when Yorkshire iron costs £20 or more a ton, and when steel tyres can be obtained for a fraction of the cost, without even considering the extra mileage obtained from the steel tyres? Prof. Adams tells us in paragraph 65 of the important process of casehardening wrought iron by heating it in contact with prussiate of potash, &c. In the opinion of many, ordinary bones used in the same way give far better results; and another way of obtaining the same result is to use wood charcoal, soda ash and a little lime. These give excellent results and are generally in use by manufacturers of locomotives and the like. Casehardening in many cases may extend to a depth of $\frac{3}{32}$ inch in important details of valve motions; pins and less important parts may do with a casing of $\frac{1}{16}$ inch in depth.

Paragraph 187 deals with cleaning castings, and here the author would put manufacturers "up to wrinkles," which they certainly are not ignorant of! He speaks of "Holes (we presume he means blow holes) stopped with black putty, cement, or lead." This is all very well in its way, but a casting requiring such treatment should be broken up and sent to the scrap heap. In paragraph 358 the author recommends that safety valves for boilers should have flat faces to prevent sticking. This is not the view taken by locomotive engineers. The most satisfactory valve is one with a conical seat fitted with three or four wings to keep it in position. The actual bearing of the valve on its seat should be about $\frac{1}{16}$ inch wide, or difficulty will be experienced in keeping it tight. In paragraph 369 new boilers are said to be tested to twice their working pressure in the best practice. The author must mean with hydraulic pressure, although he does not say so. This is certainly not the case with new locomotive boilers, nor is it to be recommended on any considerations. The bursting pressure required for any particular boiler can be approximately calculated near enough for all practical purposes, and with a suitable factor of safety allowed there is no necessity for this high test pressure on a boiler. To put a test pressure on a boiler much above its working pressure is to subject it to undue and unnecessary strains, and serves no useful purpose. The usual hydraulic test for a new locomotive boiler does not exceed 50 or 60 lbs. per square inch—about the working steam pressure. This is quite sufficient for the detection of bad workmanship, which is mainly the object of the test. The only satisfactory way to test a boiler is to have it periodically thoroughly inspected by a competent man. The mere testing a boiler with hydraulic pressure is no guarantee that the boiler is fit for work.

Paragraph 398, on the tractive force of a locomotive, is interesting. The reader is told that "the mean effective pressure on the piston is commonly assumed to be 85 per cent. of the boiler pressure." This wholly depends on circumstances. The speed of the engine and the cut-off have everything to do with the mean effective pressure. A heavy 6-coupled goods engine may occasionally exert a tractive force corresponding to a mean effective pressure of 85 per cent. of the working pressure, when starting a heavy train; but, as the speed increases, the cut-off is regulated by the driver and becomes earlier. With a working pressure of 150 pounds, with such an engine, and a cut-off of 30 per cent., the mean effective pressure becomes about 69 pounds per square inch, or about 46 per cent. of the working pressure. A mean effective pressure of 85 per cent of the boiler pressure corresponds to a cut-off of approximately 70 per cent. of the stroke or, in other words, the engine is in full gear. It is necessary to assume the highest possible mean effective pressure when the necessary weight on the driving or coupled wheels is being determined for adhesion, since the adhesive weight is in a fixed proportion to the maximum tractive force exerted; but for the purpose of determining the tractive force of a locomotive under varying conditions of speed and cut-off, the mean effective pressure of the steam in the cylinders will be found to be a varying quantity, as may be seen by studying the excellent paper on locomotives, read by the late Mr. William Stroudley before the Institution of Civil Engineers.

It is not necessary to say anything further on these points. The volume contains a mine of information. The theoretical portion is not unduly burdened with complicated formulæ. Those used are simple, and easily used by those not well up in the higher mathematics. Mechanical engineers have to thank Prof. Adams for putting within their reach a most useful book, clearly and concisely written, nicely printed and well bound, and one that certainly ought to be much used by mechanical engineers and those of the allied professions.

N. J. L.

FOSSIL FLORA OF AUSTRALIA.

On the Coal and Plant-bearing Beds of Palæozoic and Mesozoic Age in Eastern Australia and Tasmania; with Special Reference to the Fossil Flora. By B. O. Feistmantel. Memoirs of the Geological Survey of New South Wales, 1890. (Sydney: Charles Potter, Government Printer.)

THIS work is a translation from the author's older work in the "Palæontographica," amended to 1887, edited by R. Etheridge, Jun., Government Palæontologist, and with notes by the Geological Surveyor-in-charge. The greatest development of the older beds occurs in New South Wales, where the coals, sandstones, and shales with plant impressions, are intercalated with porphyries to the thickness of 14,000 feet. Two remarkable facts give special interest to the beds: one is that under beds with Conularia, Spirifer, and Productus, believed to be Upper Carboniferous, certain plants of Mesozoic type appear; and the other, that just under these plant beds there are conglomerates regarded as having been deposited by the action of ice. The formations in New South Wales, Queensland, Victoria, and Tasmania, are described separately, but together they form a series; commencing with the Devonian Goonoo Goonoo, containing Lepidodendron; the Lower Carboniferous Lepidodendron beds; the Boulder beds, showing signs of glacial action, correlated with the similar Dwyka Conglomerate of Africa, and the Talchir Boulder bed of India; the lower marine beds of Upper Carboniferous age, followed by coal measures with Glossopteris, and an upper marine series; the Permian Newcastle beds with Glossopteris and heterocercal fish; the Hawkesbury Trias with

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